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FIG. 1

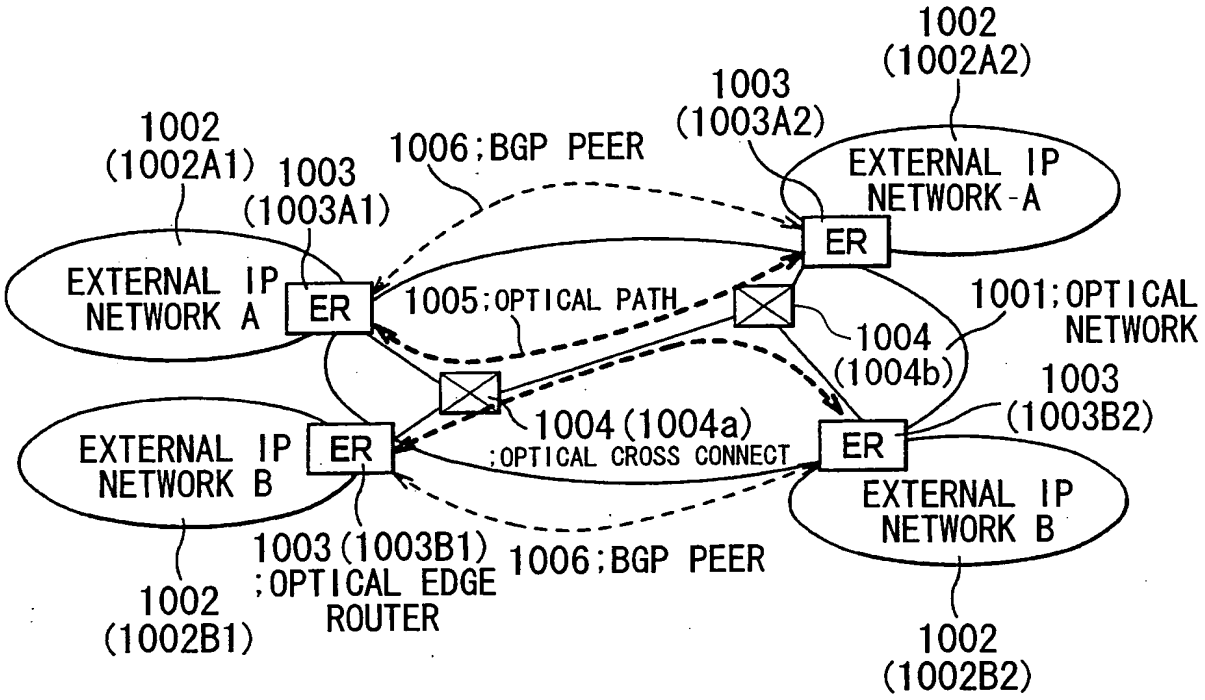

FIG. 2

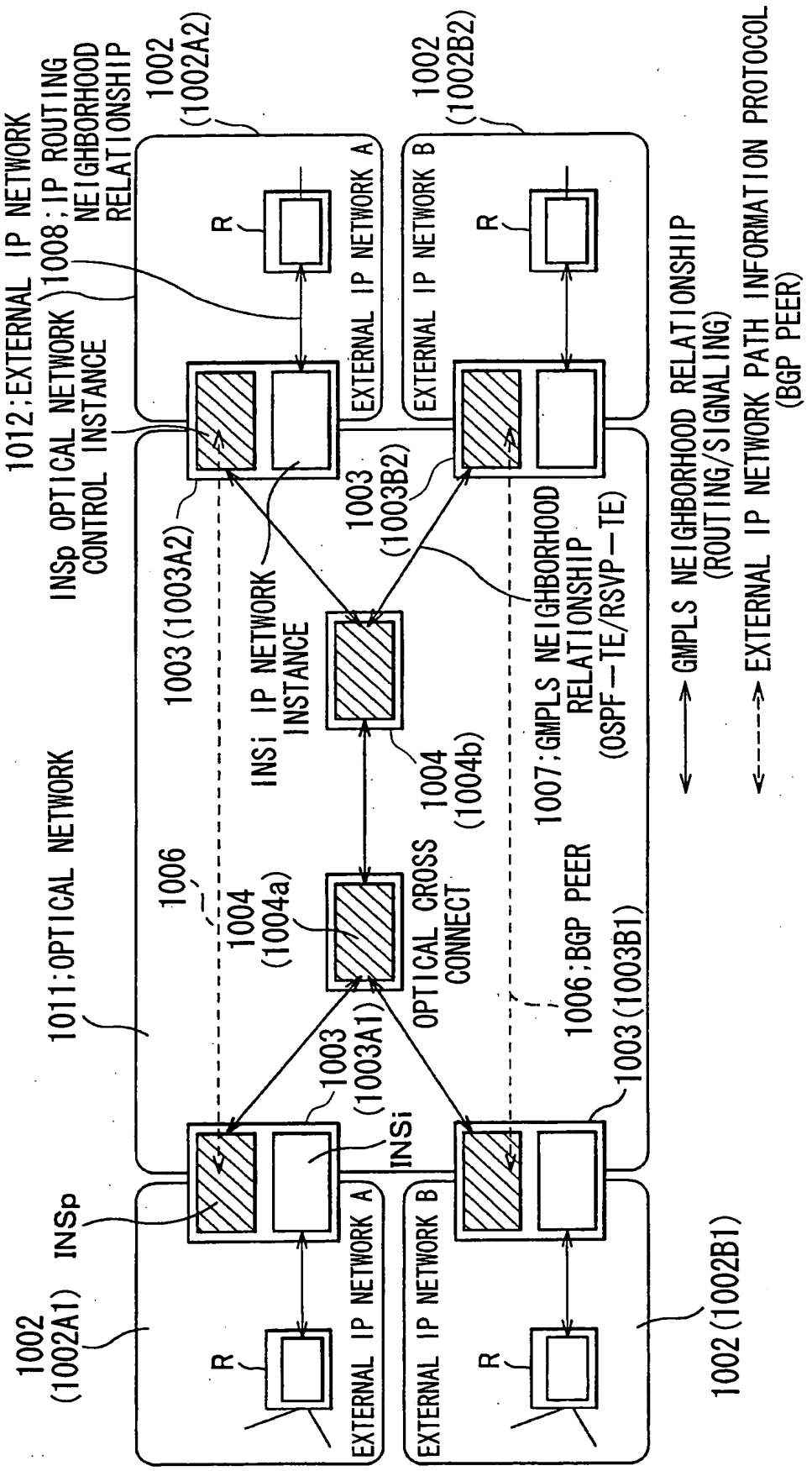
1012;EXTERNAL IP NETWORK
INSp OPTICAL NETWORK CONTROL INSTANCE
1008;IP ROUTING NEIGHBORHOOD RELATIONSHIP
1002 (1002A2)
1002 (1002B2)
EXTERNAL IP NETWORK A
EXTERNAL IP NETWORK B
R
1003 (1003A2)
1003 (1003B2)
INSi IP NETWORK INSTANCE
1004 (1004b)
1004 (1004a)
1006
1007;GMPLS NEIGHBORHOOD RELATIONSHIP (OSPF—TE/RSVP—TE)
1011;OPTICAL NETWORK
OPTICAL CROSS CONNECT
1006;BGP PEER
1003 (1003A1)
1003 (1003B1)
INSi
INSp
1002 (1002A1)
1002 (1002B1)
GMPLS NEIGHBORHOOD RELATIONSHIP (ROUTING/SIGNALING)
EXTERNAL IP NETWORK PATH INFORMATION PROTOCOL (BGP PEER)

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FIG. 3

ROUTING TABLE(IP NETWORK ROUTING TABLE)

Destination network address	Address mask	Next hop
xx. xx. xx. x	xxx. x. x. x	xxx. xx. xx. xx
x. xx. x. xx	xxx. xxx. xx. x	direct
...	...	...

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FIG. 4

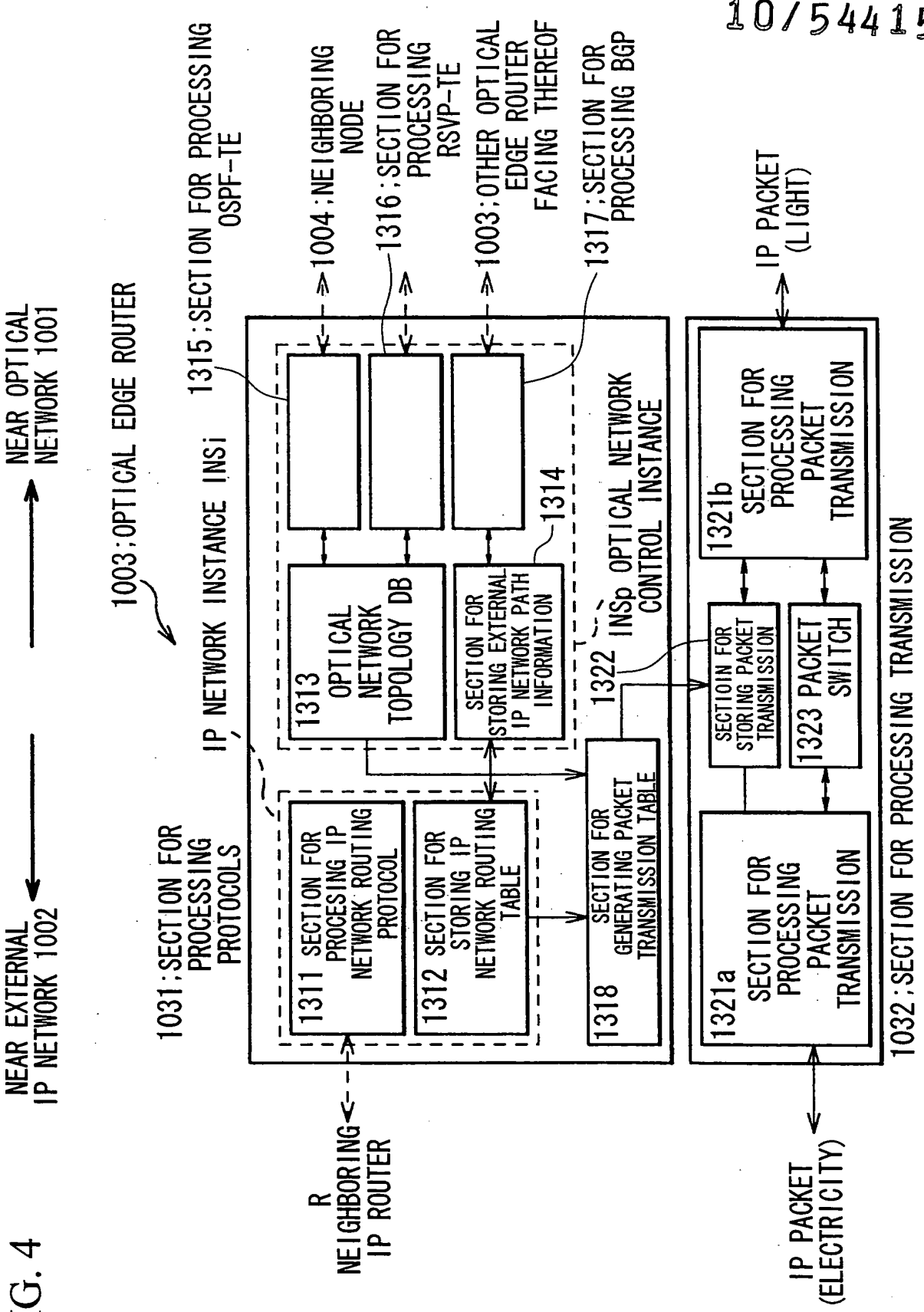


FIG. 5

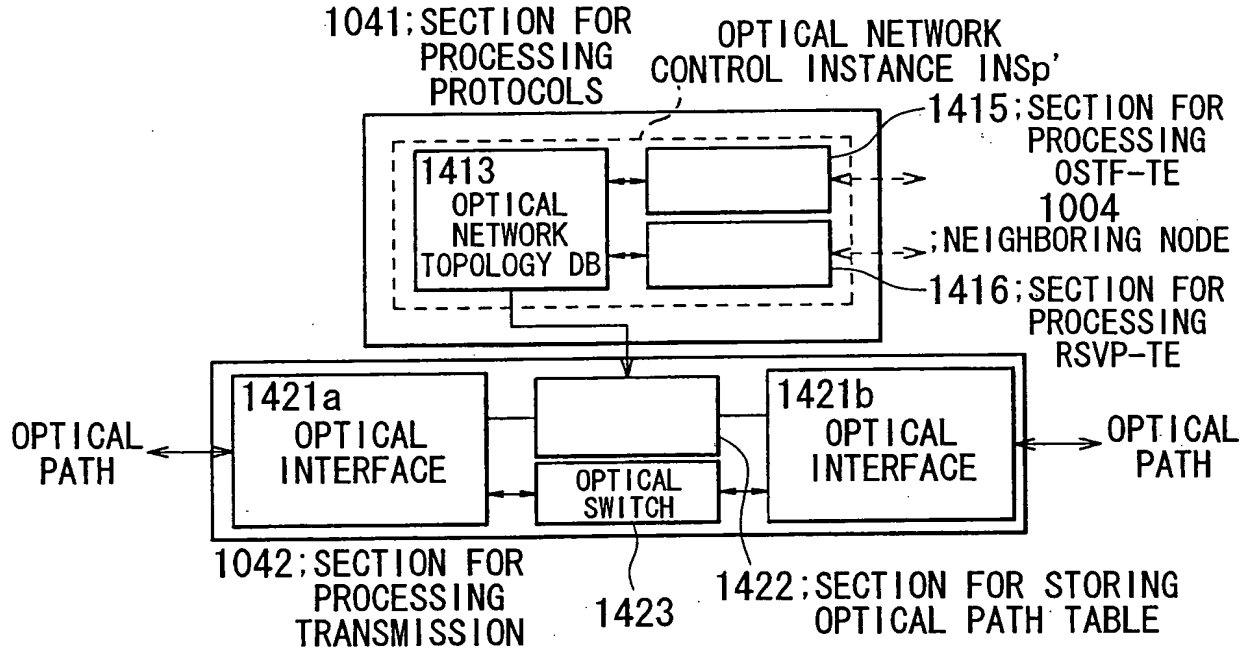
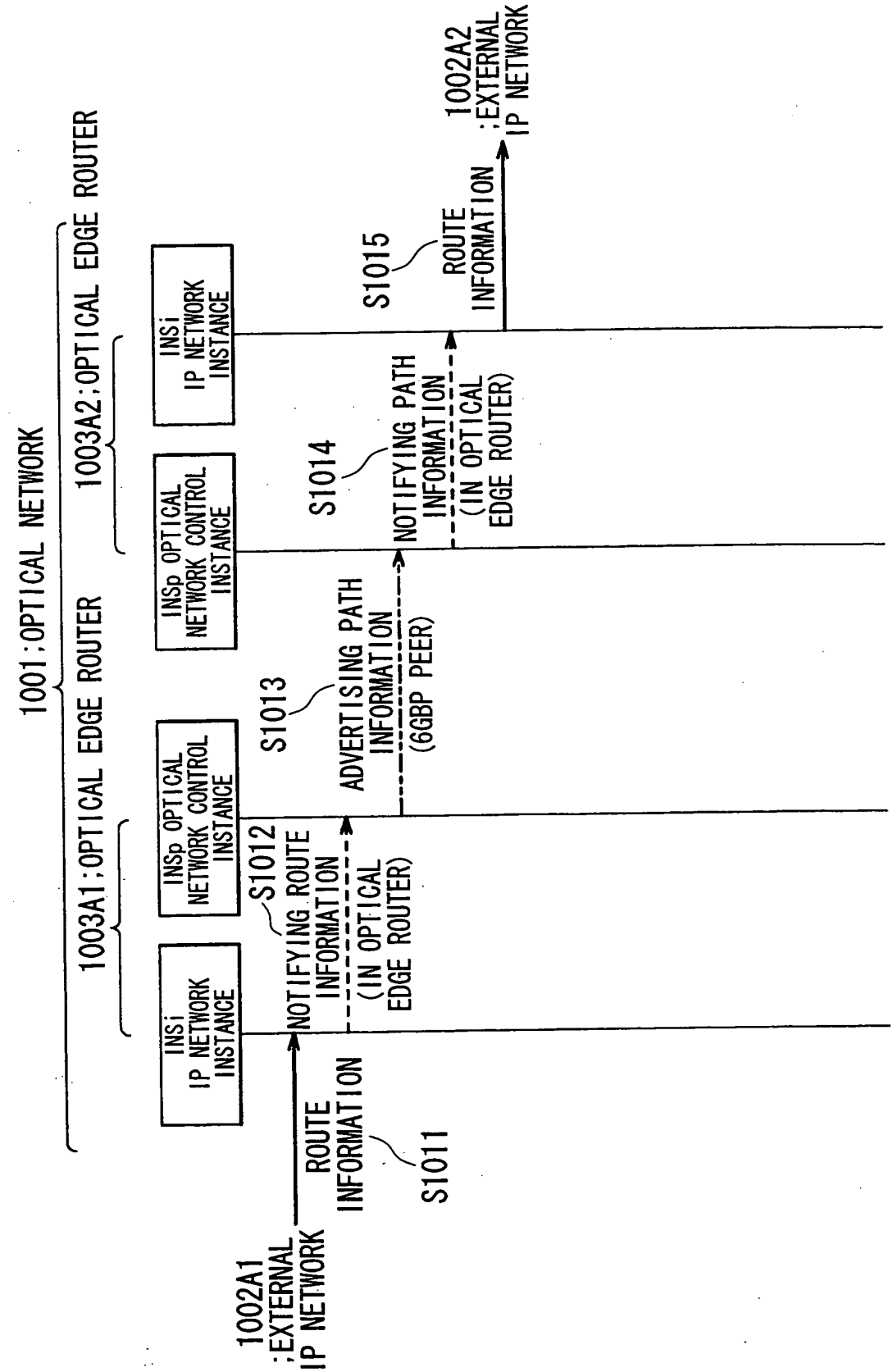

1041;SECTION FOR PROCESSING PROTOCOLS
OPTICAL NETWORK CONTROL INSTANCE INSp'
1415;SECTION FOR PROCESSING OSTF-TE
1413 OPTICAL NETWORK TOPOLOGY DB
1004 ;NEIGHBORING NODE
1416;SECTION FOR PROCESSING RSVP-TE
1421a OPTICAL INTERFACE
1421b OPTICAL INTERFACE
OPTICAL PATH
OPTICAL PATH
OPTICAL SWITCH
1042;SECTION FOR PROCESSING TRANSMISSION
1423
1422;SECTION FOR STORING OPTICAL PATH TABLE

FIG. 6


1001:OPTICAL NETWORK
1003A1:OPTICAL EDGE ROUTER
1003A2:OPTICAL EDGE ROUTER
1002A1 :EXTERNAL IP NETWORK
1002A2 :EXTERNAL IP NETWORK
INSi IP NETWORK INSTANCE
INSp OPTICAL NETWORK CONTROL INSTANCE
INSp OPTICAL NETWORK CONTROL INSTANCE
INSi IP NETWORK INSTANCE
ROUTE INFORMATION
S1011
NOTIFYING ROUTE INFORMATION (IN OPTICAL EDGE ROUTER)
S1012
ADVERTISING PATH INFORMATION (6GBP PEER)
S1013
NOTIFYING PATH INFORMATION (IN OPTICAL EDGE ROUTER)
S1014
S1015
ROUTE INFORMATION

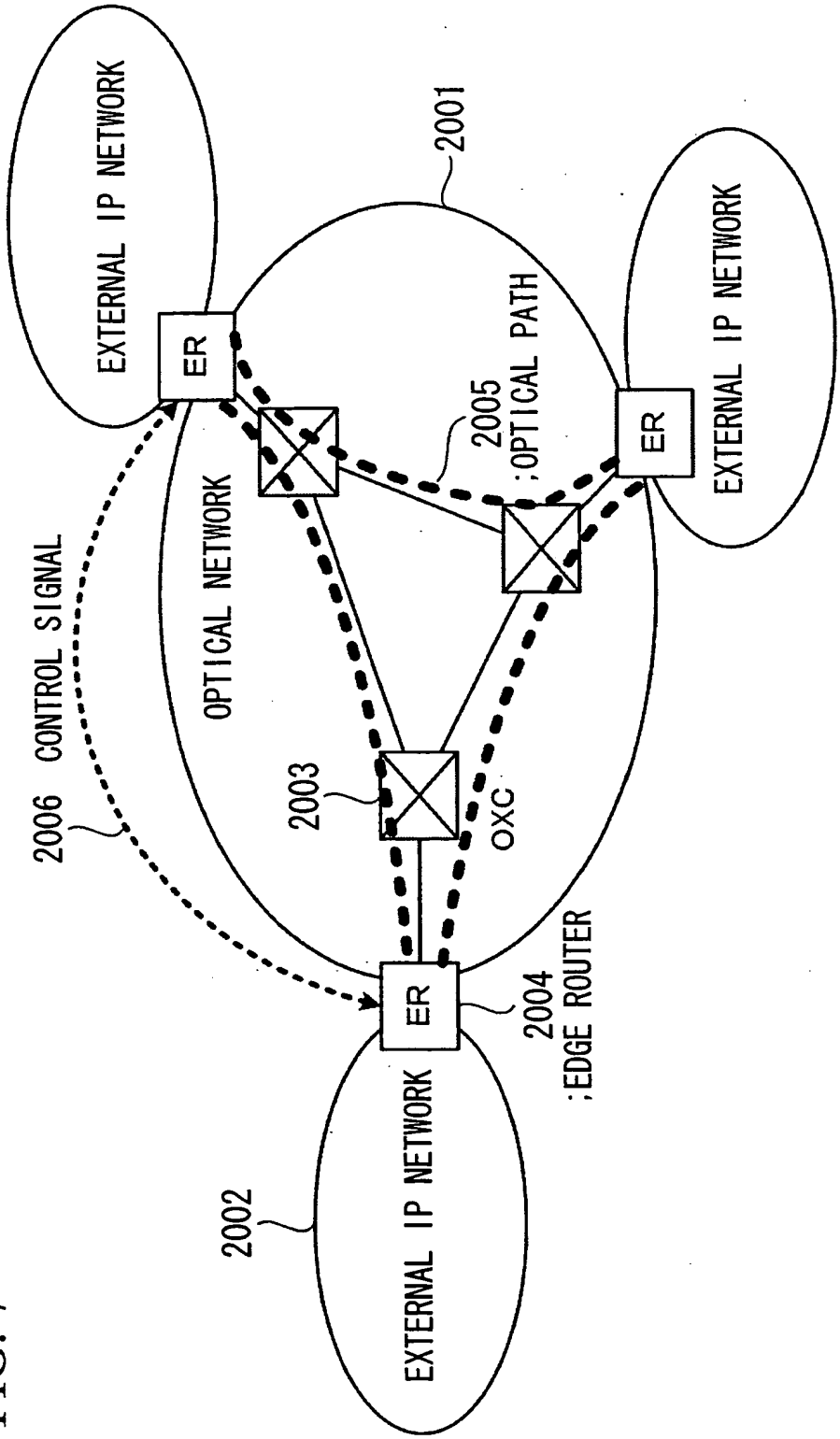

EXTERNAL IP NETWORK
2001
ER
2005
:OPTICAL PATH
ER
EXTERNAL IP NETWORK
OPTICAL NETWORK
2006 CONTROL SIGNAL
2003
OXC
ER
2004
:EDGE ROUTER
2002
EXTERNAL IP NETWORK

FIG. 7

FIG. 8

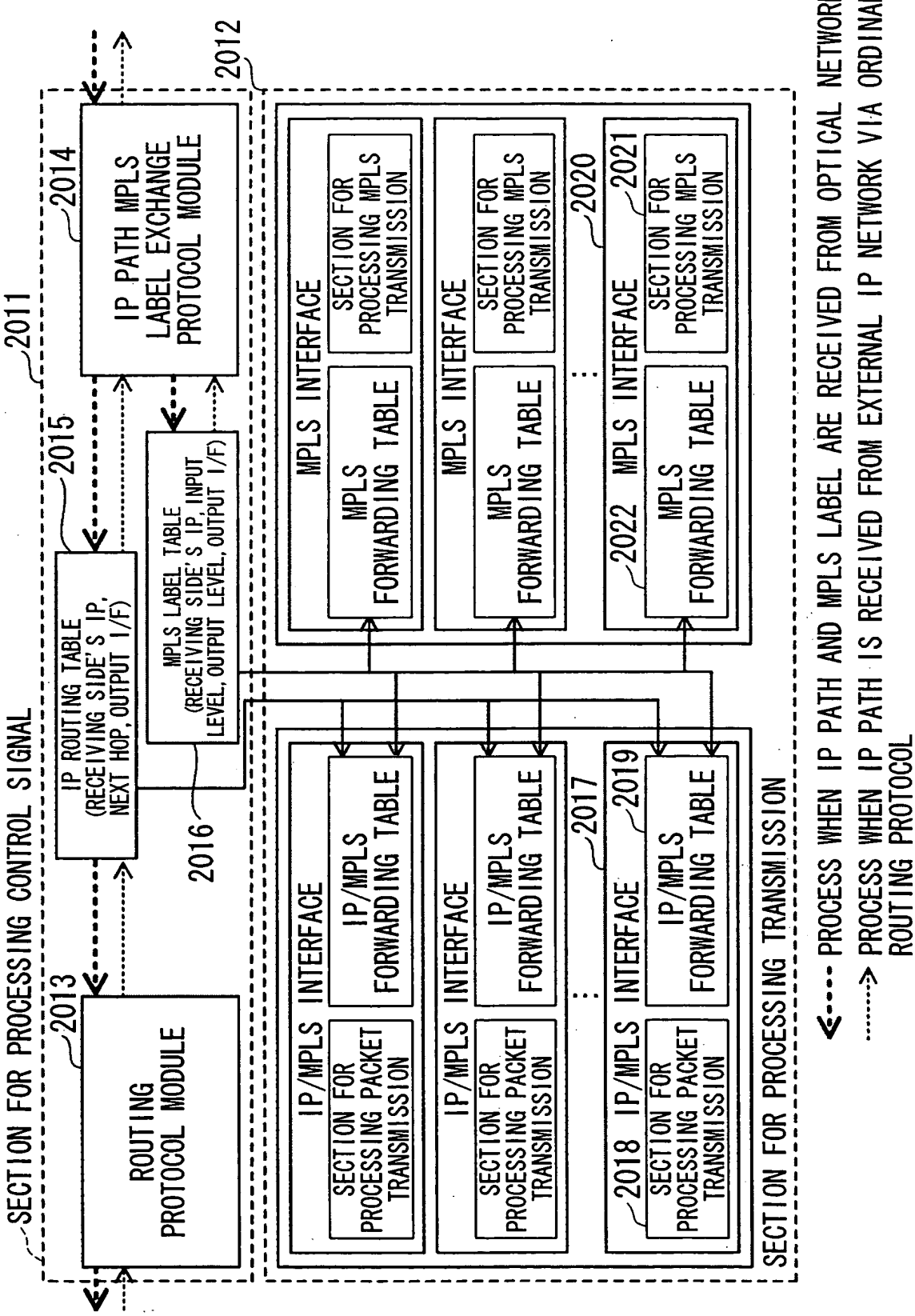

SECTION FOR PROCESSING CONTROL SIGNAL
2011
2012
2013
ROUTING PROTOCOL MODULE
2014
IP PATH MPLS LABEL EXCHANGE PROTOCOL MODULE
2015
IP ROUTING TABLE (RECEIVING SIDE'S IP, NEXT HOP, OUTPUT I/F)
MPLS LABEL TABLE (RECEIVING SIDE'S IP, INPUT LEVEL, OUTPUT LEVEL, OUTPUT I/F)
2016
SECTION FOR PROCESSING TRANSMISSION
IP/MPLS INTERFACE
SECTION FOR PROCESSING PACKET TRANSMISSION
IP/MPLS FORWARDING TABLE
2017
2018 IP/MPLS INTERFACE
2019
MPLS INTERFACE
SECTION FOR PROCESSING MPLS TRANSMISSION
MPLS FORWARDING TABLE
2020
2021
2022 MPLS INTERFACE
PROCESS WHEN IP PATH AND MPLS LABEL ARE RECEIVED FROM OPTICAL NETWORK
PROCESS WHEN IP PATH IS RECEIVED FROM EXTERNAL IP NETWORK VIA ORDINARY ROUTING PROTOCOL

FIG. 9

2031 RECEIVING SIDE'S IP ADDRESS	2032 INPUT LABEL VALUE	2033 OUTPUT LABEL VALUE	2034 OUTPUT INTERFACE
100.1.0.0/16	—	105	5
100.2.1.0/24	100	—	1
100.2.2.0/24	345	—	2

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FIG. 10

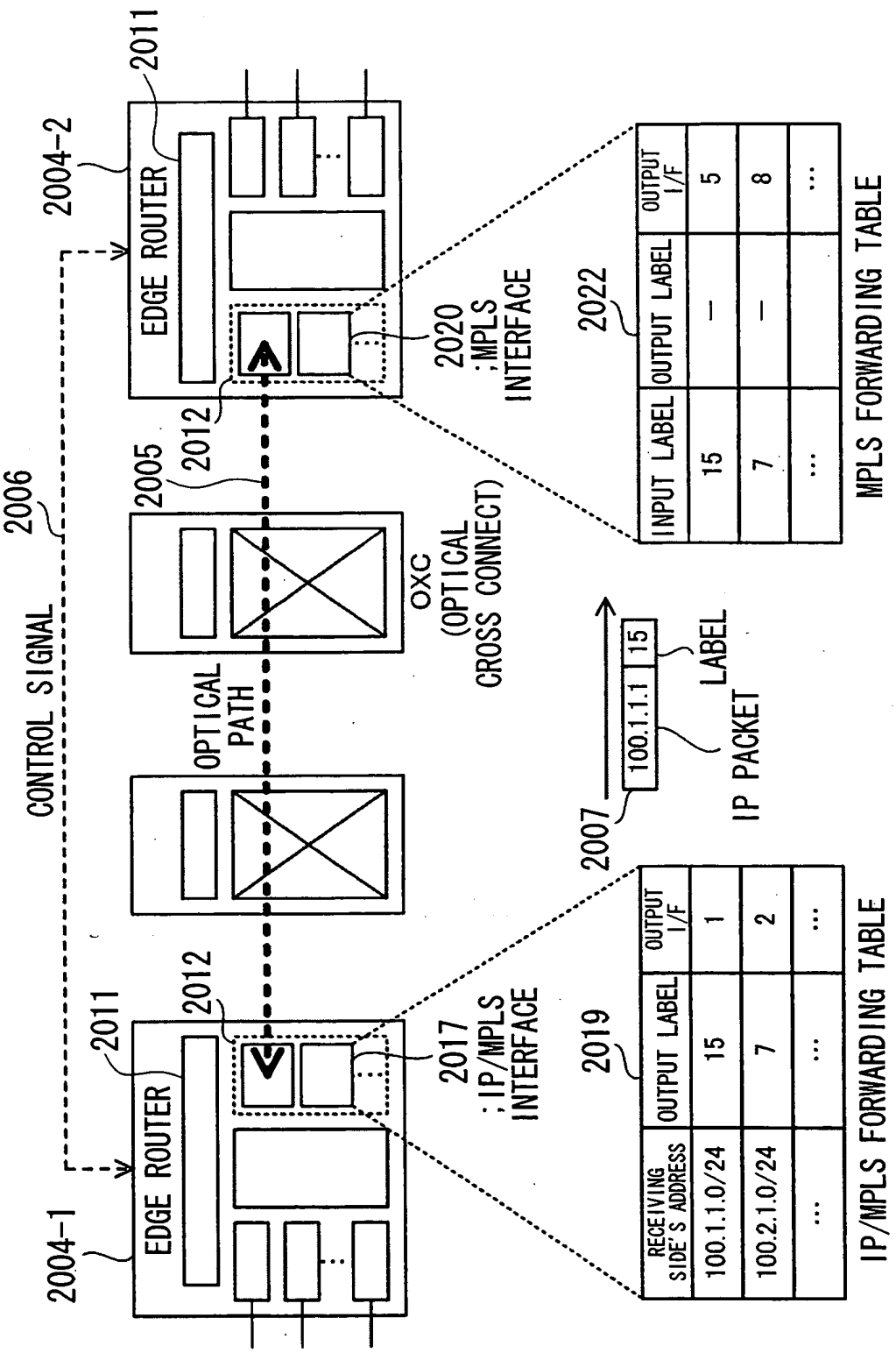


FIG. 11

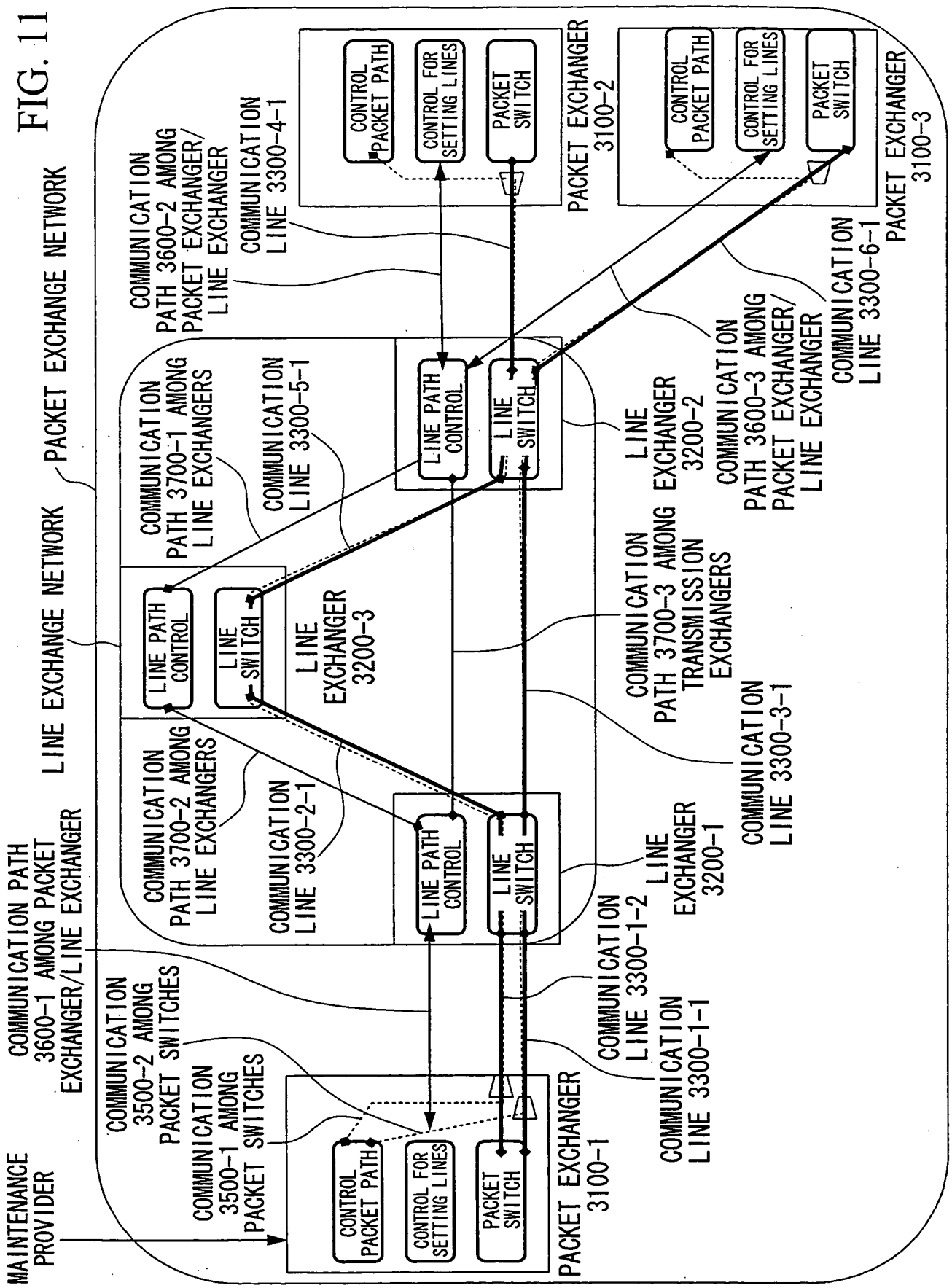
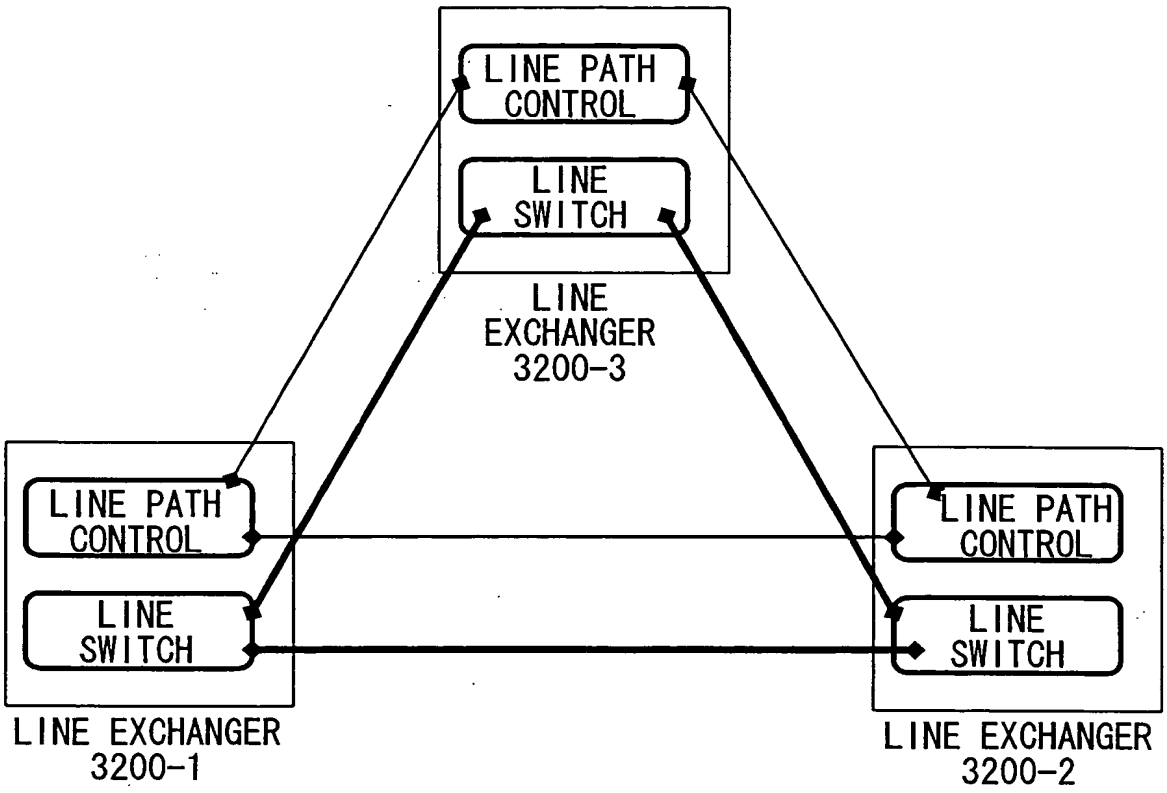

PACKET EXCHANGE NETWORK
LINE EXCHANGE NETWORK
MAINTENANCE PROVIDER
COMMUNICATION PATH 3600-1 AMONG PACKET EXCHANGER/LINE EXCHANGER
COMMUNICATION 3500-2 AMONG PACKET SWITCHES
COMMUNICATION 3500-1 AMONG PACKET SWITCHES
CONTROL PACKET PATH
CONTROL FOR SETTING LINES
PACKET SWITCH
PACKET EXCHANGER 3100-1
PACKET EXCHANGER 3100-2
PACKET EXCHANGER 3100-3
LINE PATH CONTROL
LINE SWITCH
LINE EXCHANGER 3200-1
LINE EXCHANGER 3200-2
LINE EXCHANGER 3200-3
COMMUNICATION PATH 3700-1 AMONG LINE EXCHANGERS
COMMUNICATION PATH 3700-2 AMONG LINE EXCHANGERS
COMMUNICATION PATH 3700-3 AMONG TRANSMISSION EXCHANGERS
COMMUNICATION PATH 3600-2 AMONG PACKET EXCHANGER/LINE EXCHANGER
COMMUNICATION PATH 3600-3 AMONG PACKET EXCHANGER/LINE EXCHANGER
COMMUNICATION LINE 3300-1-1
COMMUNICATION LINE 3300-1-2
COMMUNICATION LINE 3300-2-1
COMMUNICATION LINE 3300-3-1
COMMUNICATION LINE 3300-4-1
COMMUNICATION LINE 3300-5-1
COMMUNICATION LINE 3300-6-1

FIG. 12


LINE PATH CONTROL
LINE SWITCH
LINE EXCHANGER 3200-3
LINE PATH CONTROL
LINE SWITCH
LINE EXCHANGER 3200-1
LINE PATH CONTROL
LINE SWITCH
LINE EXCHANGER 3200-2

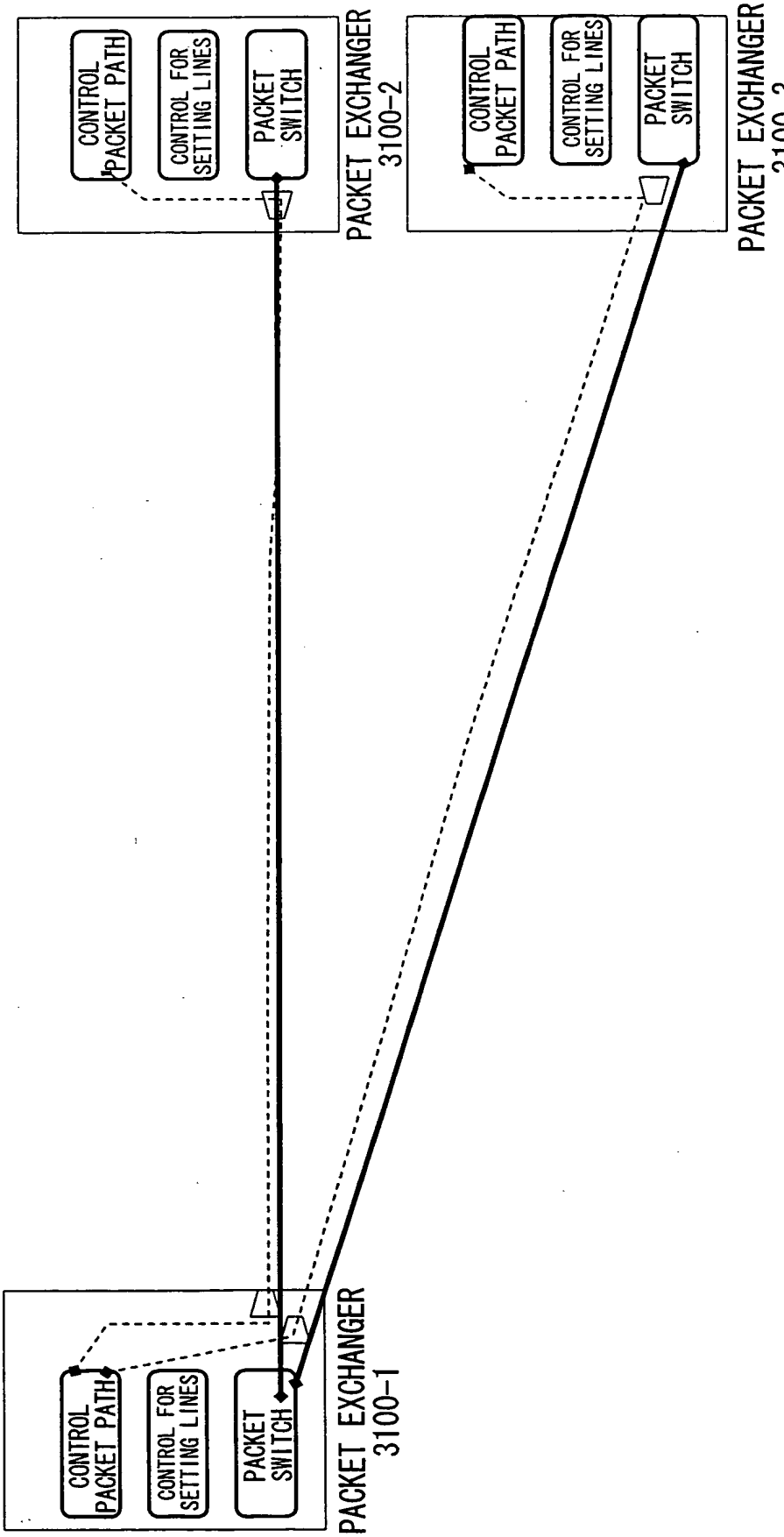
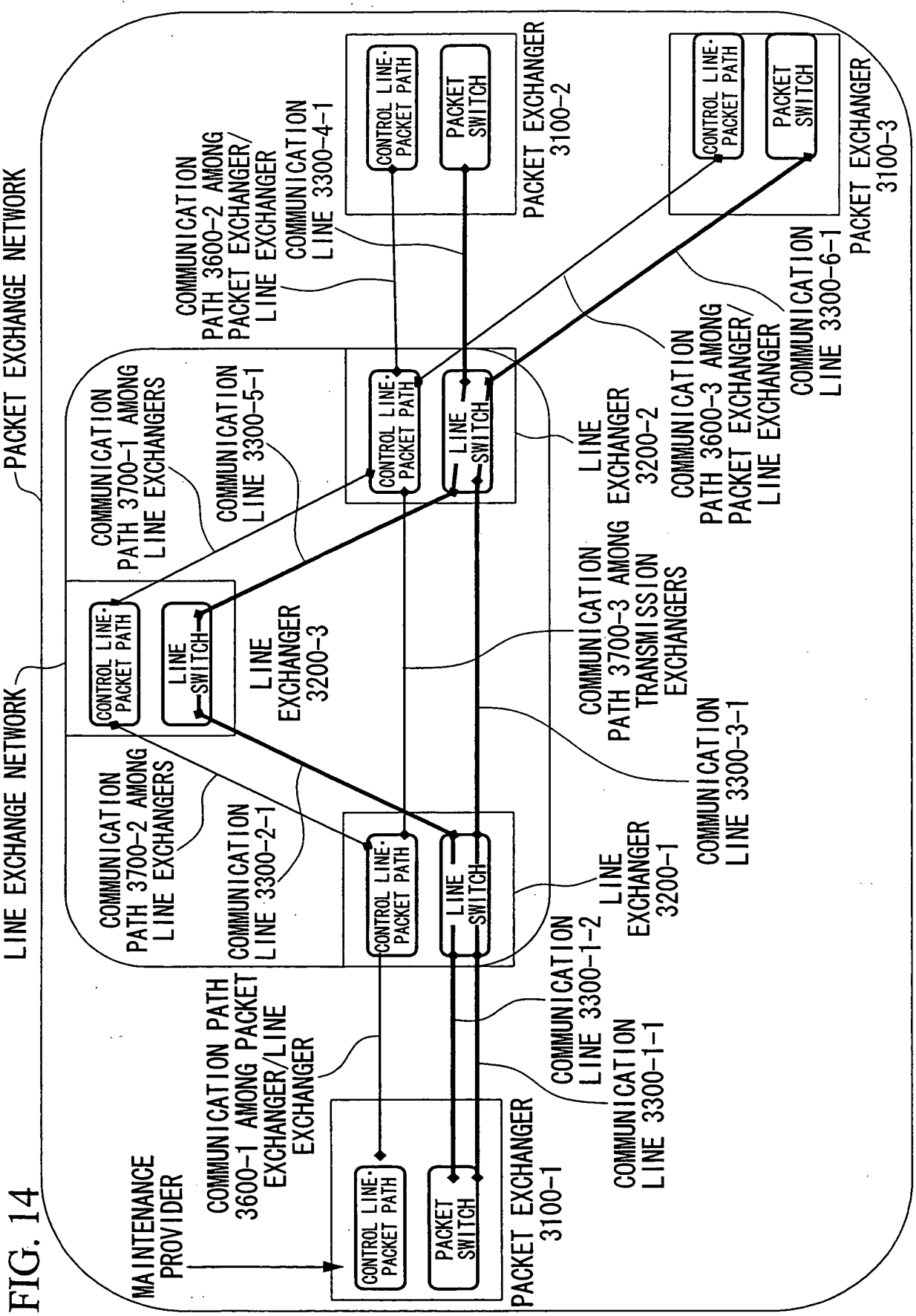

CONTROL PACKET PATH
CONTROL FOR SETTING LINES
PACKET SWITCH
PACKET EXCHANGER 3100-2
CONTROL PACKET PATH
CONTROL FOR SETTING LINES
PACKET SWITCH
PACKET EXCHANGER 3100-3
CONTROL PACKET PATH
CONTROL FOR SETTING LINES
PACKET SWITCH
PACKET EXCHANGER 3100-1

FIG. 13

FIG. 14


PACKET EXCHANGE NETWORK
LINE EXCHANGE NETWORK
MAINTENANCE PROVIDER
COMMUNICATION PATH 3600-1 AMONG PACKET EXCHANGER/LINE EXCHANGER
PACKET EXCHANGER 3100-1
CONTROL LINE·PACKET PATH
PACKET SWITCH
COMMUNICATION LINE 3300-1-1
COMMUNICATION LINE 3300-1-2
LINE EXCHANGER 3200-1
LINE SWITCH
COMMUNICATION PATH 3700-2 AMONG LINE EXCHANGERS
COMMUNICATION LINE 3300-2-1
COMMUNICATION PATH 3700-1 AMONG LINE EXCHANGERS
COMMUNICATION LINE 3300-5-1
LINE EXCHANGER 3200-3
COMMUNICATION PATH 3700-3 AMONG TRANSMISSION EXCHANGERS
COMMUNICATION LINE 3300-3-1
COMMUNICATION PATH 3600-2 AMONG PACKET EXCHANGER/LINE EXCHANGER
COMMUNICATION LINE 3300-4-1
PACKET EXCHANGER 3100-2
LINE EXCHANGER 3200-2
COMMUNICATION PATH 3600-3 AMONG PACKET EXCHANGER/LINE EXCHANGER
COMMUNICATION LINE 3300-6-1
PACKET EXCHANGER 3100-3

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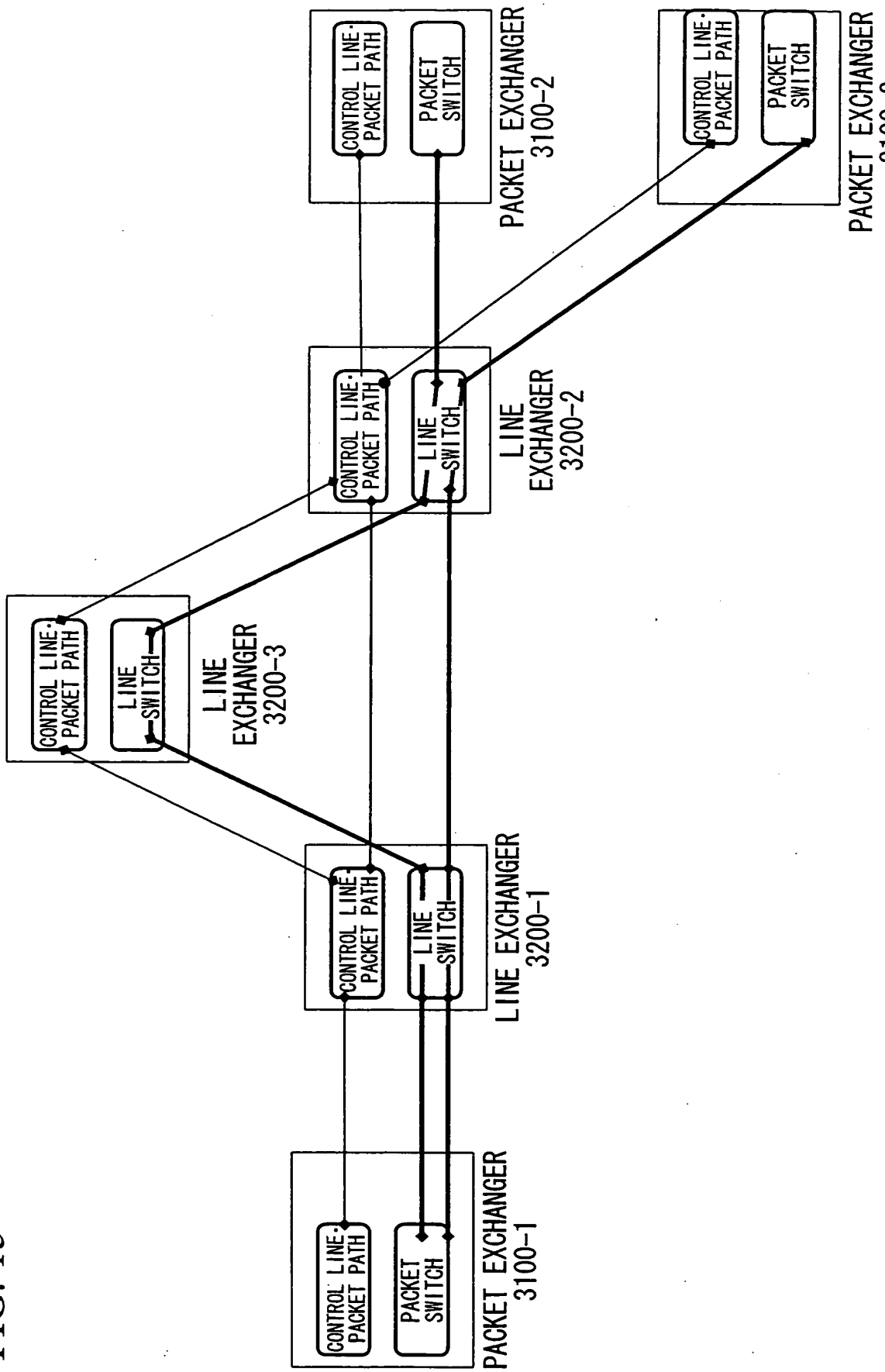
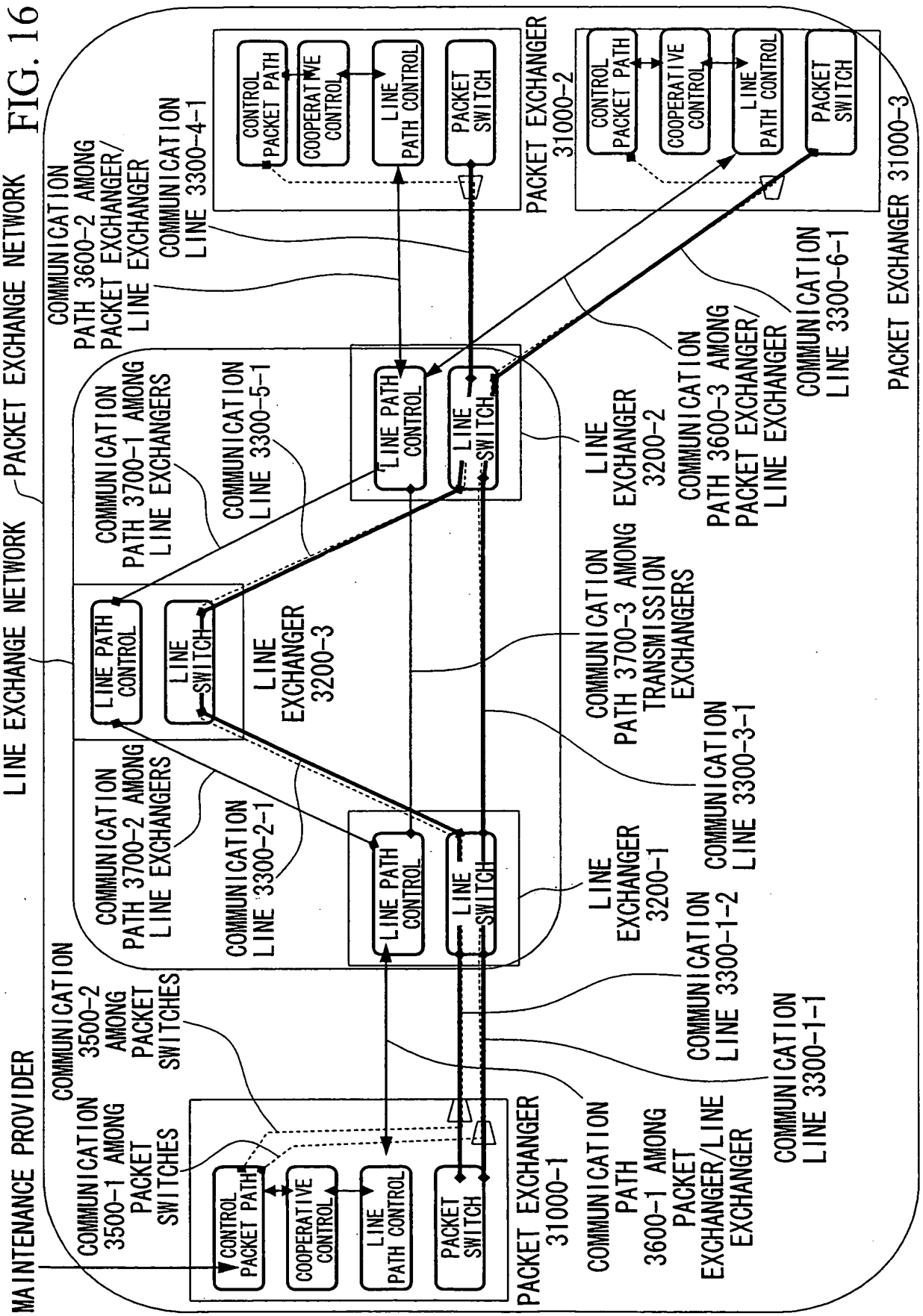


FIG. 15

FIG. 16


MAINTENANCE PROVIDER
LINE EXCHANGE NETWORK
PACKET EXCHANGE NETWORK
COMMUNICATION 3500-1 AMONG PACKET SWITCHES
COMMUNICATION 3500-2 AMONG PACKET SWITCHES
CONTROL PACKET PATH
COOPERATIVE CONTROL
LINE PATH CONTROL
PACKET SWITCH
PACKET EXCHANGER 31000-1
COMMUNICATION PATH 3600-1 AMONG PACKET EXCHANGER/LINE EXCHANGER
COMMUNICATION LINE 3300-1-1
COMMUNICATION LINE 3300-1-2
LINE EXCHANGER 3200-1
COMMUNICATION PATH 3700-2 AMONG LINE EXCHANGERS
COMMUNICATION LINE 3300-2-1
LINE PATH CONTROL
LINE SWITCH
LINE EXCHANGER 3200-3
COMMUNICATION PATH 3700-1 AMONG LINE EXCHANGERS
COMMUNICATION LINE 3300-5-1
COMMUNICATION PATH 3700-3 AMONG TRANSMISSION EXCHANGERS
COMMUNICATION LINE 3300-3-1
LINE EXCHANGER 3200-2
COMMUNICATION PATH 3600-3 AMONG PACKET EXCHANGER/LINE EXCHANGER
COMMUNICATION LINE 3300-6-1
PACKET EXCHANGER 31000-3
COMMUNICATION PATH 3600-2 AMONG PACKET EXCHANGER/LINE EXCHANGER
COMMUNICATION LINE 3300-4-1
PACKET EXCHANGER 31000-2

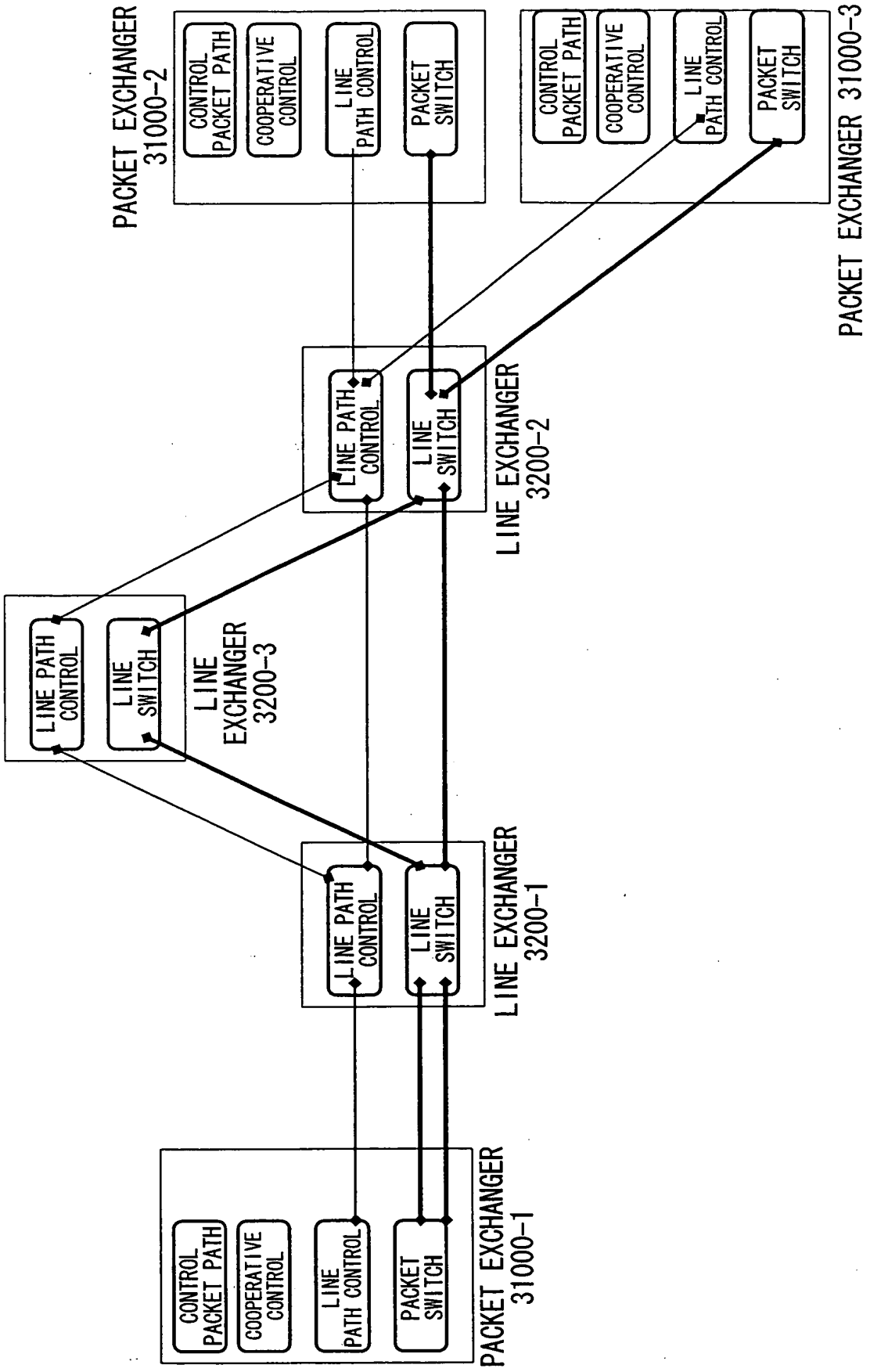

PACKET EXCHANGER 31000-2
CONTROL PACKET PATH
COOPERATIVE CONTROL
LINE PATH CONTROL
PACKET SWITCH
PACKET EXCHANGER 31000-3
CONTROL PACKET PATH
COOPERATIVE CONTROL
LINE PATH CONTROL
PACKET SWITCH
LINE EXCHANGER 3200-2
LINE PATH CONTROL
LINE SWITCH
LINE EXCHANGER 3200-3
LINE PATH CONTROL
LINE SWITCH
LINE EXCHANGER 3200-1
LINE PATH CONTROL
LINE SWITCH
PACKET EXCHANGER 31000-1
CONTROL PACKET PATH
COOPERATIVE CONTROL
LINE PATH CONTROL
PACKET SWITCH

FIG. 17

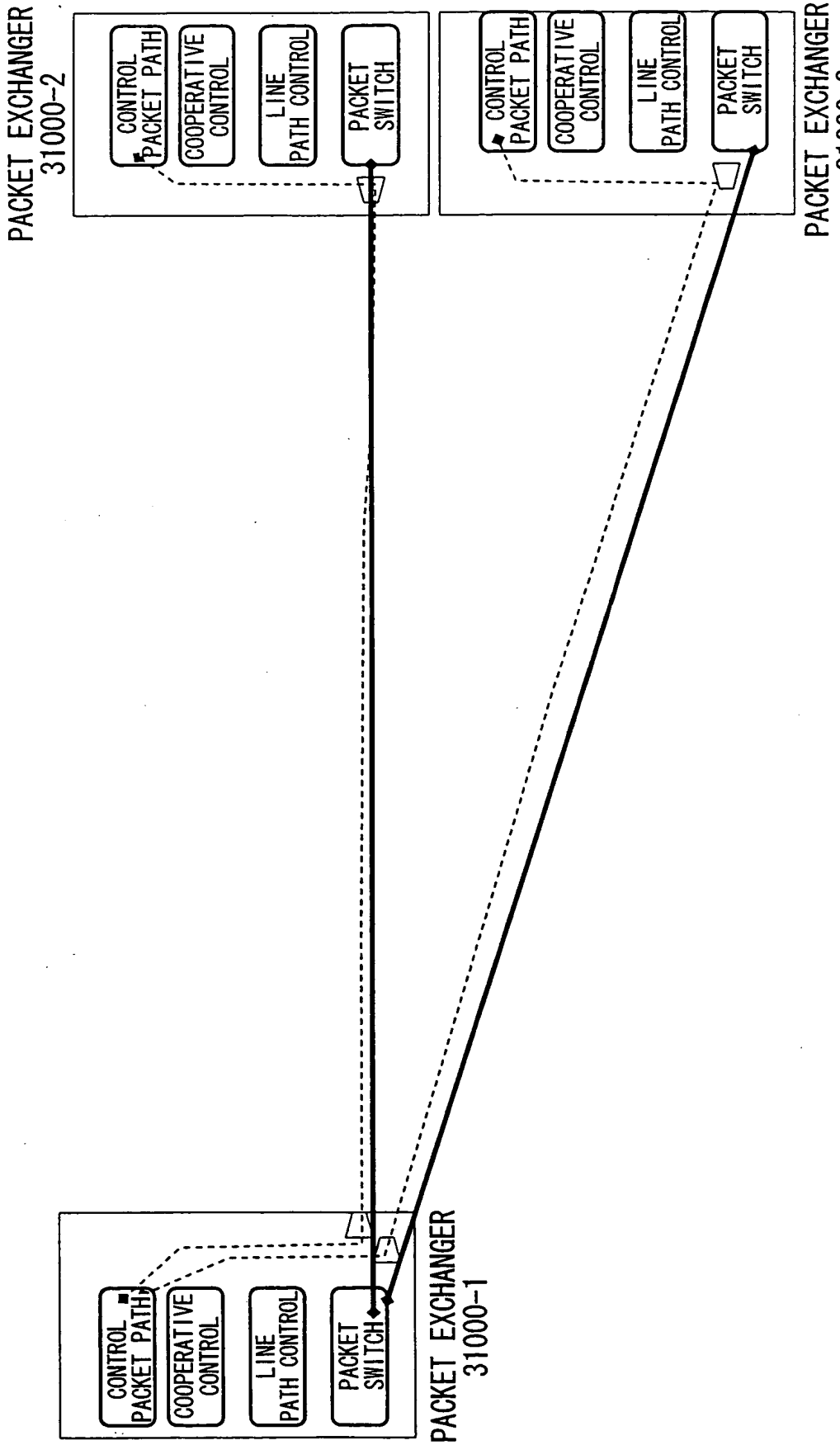
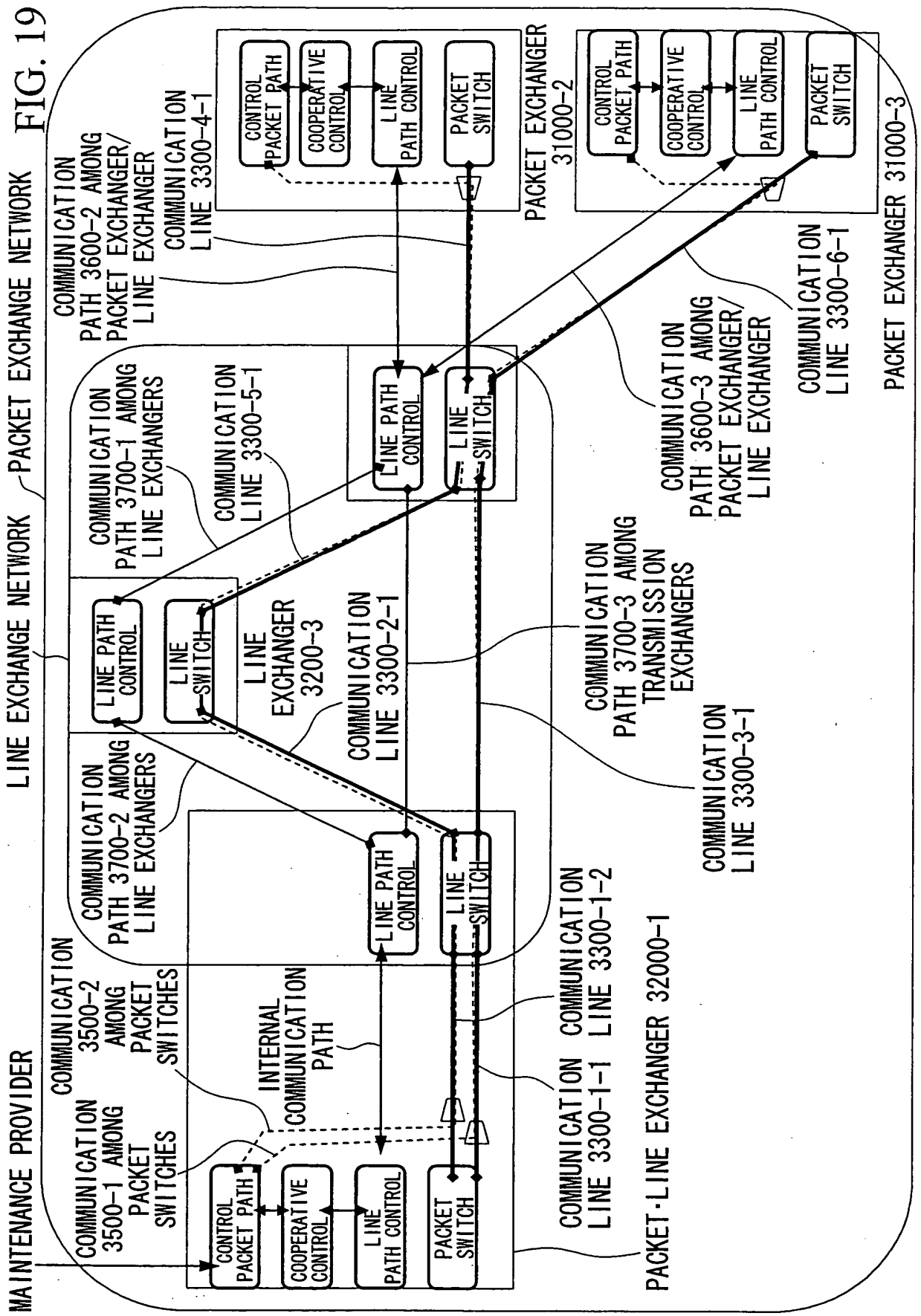

PACKET EXCHANGER 31000-2
CONTROL PACKET PATH
COOPERATIVE CONTROL
LINE PATH CONTROL
PACKET SWITCH
PACKET EXCHANGER 31000-3
CONTROL PACKET PATH
COOPERATIVE CONTROL
LINE PATH CONTROL
PACKET SWITCH
PACKET EXCHANGER 31000-1
CONTROL PACKET PATH
COOPERATIVE CONTROL
LINE PATH CONTROL
PACKET SWITCH

FIG. 18

FIG. 19


MAINTENANCE PROVIDER
LINE EXCHANGE NETWORK
PACKET EXCHANGE NETWORK
COMMUNICATION 3500-1 AMONG PACKET SWITCHES
COMMUNICATION 3500-2 AMONG PACKET SWITCHES
INTERNAL COMMUNICATION PATH
CONTROL PACKET PATH
COOPERATIVE CONTROL
LINE PATH CONTROL
PACKET SWITCH
PACKET-LINE EXCHANGER 32000-1
COMMUNICATION LINE 3300-1-1
COMMUNICATION LINE 3300-1-2
LINE EXCHANGER 3200-3
LINE PATH CONTROL
LINE SWITCH
COMMUNICATION PATH 3700-2 AMONG LINE EXCHANGERS
COMMUNICATION LINE 3300-2-1
COMMUNICATION PATH 3700-1 AMONG LINE EXCHANGERS
COMMUNICATION LINE 3300-5-1
COMMUNICATION PATH 3700-3 AMONG TRANSMISSION EXCHANGERS
COMMUNICATION LINE 3300-3-1
COMMUNICATION PATH 3600-3 AMONG PACKET EXCHANGER/ LINE EXCHANGER
COMMUNICATION LINE 3300-6-1
PACKET EXCHANGER 31000-3
PACKET EXCHANGER 31000-2
COMMUNICATION PATH 3600-2 AMONG PACKET EXCHANGER/ LINE EXCHANGER
COMMUNICATION LINE 3300-4-1